# From **Compromised** to **Optimized**: One Data Center: **$10 million** Saved

## An ACE Performance Assessment Case Study

### Future Facilities' White Paper

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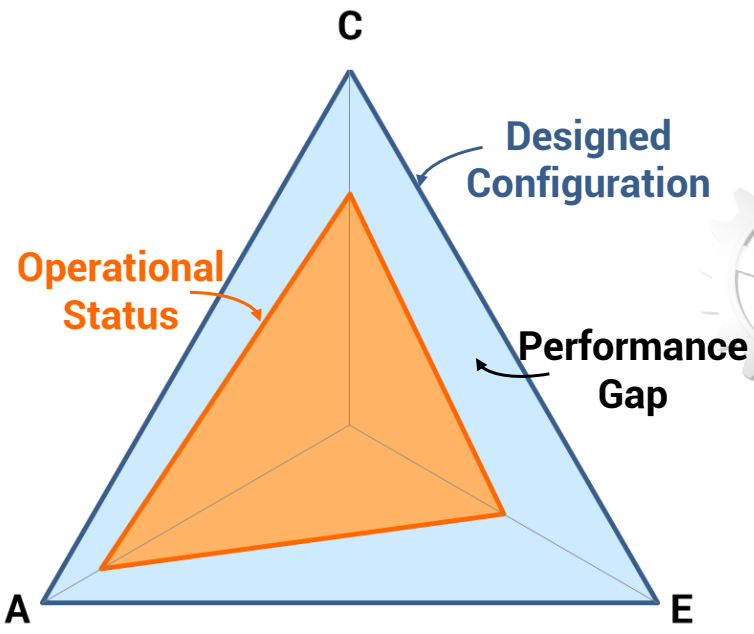


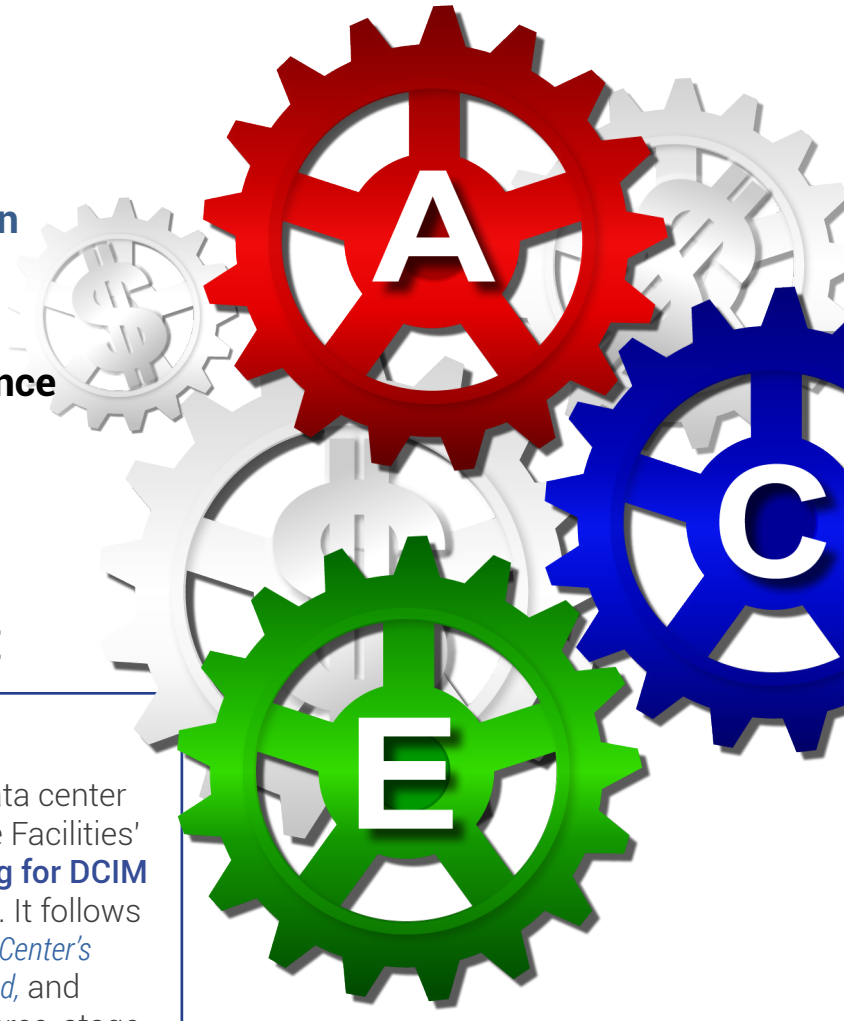


Executive Summary

This paper, written for senior managers in the data center owner-operator business, describes how Future Facilities' **ACE performance score** and **predictive modeling for DCIM** were used to save $10 million in one data center. It follows on from our previous paper, *Five Reasons your Data Center's Availability, Capacity and Efficiency are being Compromised,* and describes how we achieved these savings in a three-stage process: assess, improve, maintain.

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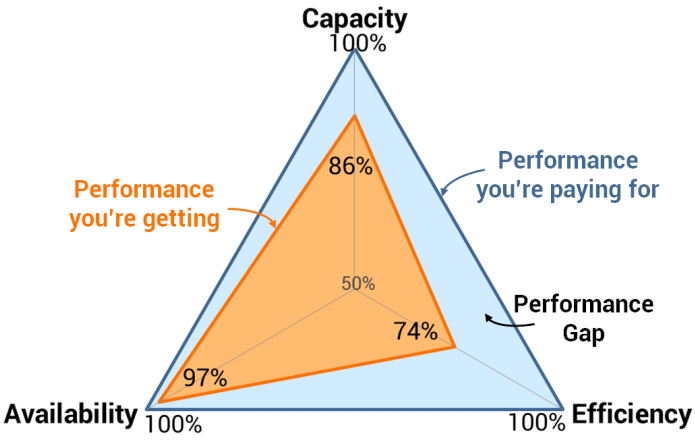
# Introduction




In the design and operational phases of data center management, there is a continuing need to meet business goals - from reducing costs to achieving optimal performance and operational flexibility.

How well a facility meets the performance demands of several stakeholder groups is ultimately decided by three intertwined variables: **availability**, physical **capacity** and cooling **efficiency** (**ACE**).

In our previous paper, *Five Reasons your Data Center's Availability, Capacity and Efficiency are being Compromised*, we established the main causes of low capacity utilization, increased downtime and cooling inefficiencies, and the impact they have on your costs.

The solution, as our customers have learned, is to manage ACE sustainably. Future Facilities' **ACE performance score** - a way of assessing how compromised your data center has become and how much operational flexibility it can offer you - allows you to do exactly that. To demonstrate this, we've written this paper to illustrate, through a real life example, how the score is today being used to meet owner-operators' aspirational goals.

Before reading on, it's really important to understand ACE: decisions that you make with regards to one aspect of ACE performance will impact upon the others. Crucially, they may do so with potentially unforeseen consequences. So, if your managers make a change to improve availability, they must be able to confidently plan for the impact that will have on physical capacity and cooling efficiency.

Despite this, the vast majority of owner-operators currently rely on fairly simple performance indicators such as PUE (Power Usage Effectiveness), which are just not capable of considering the complex ACE relationship. By contrast, the ACE performance score approaches the performance challenge **holistically**. It quantifies, and allows you to visualize, your **ACE performance gap**: the difference between the performance you're paying for and the performance you're actually getting day to day.

It is the integration of the ACE performance score with DCIM (data center infrastructure management) data that will allow you to minimize your costs predictably, repeatedly and in a sustainable way. We call this **predictive modeling for DCIM**.

In this paper, we'll show you how the ACE performance score will enable you to improve and maintain the performance of your data centers and reach more of your business goals, whether they be performance-driven or cost-driven.

**Techspeak:**

*ACE performance score*

a unique way of assessing and visualizing the three critical indicators of data center performance

**Techspeak:**

*availability*

% of existing connected IT load that will always be available under what if power and cooling failure conditions

*capacity*

% of design IT load that can achieved by adding to the present day configuration

*efficiency*

the effectiveness of airflow and temperature delivery

# The ACE Performance Score in Use. Save $10 million... per data center

In this real-life case study, the ACE assessment service was applied to a well-operated, three-year-old, Tier IV, mission critical data center. It features two data halls equipped with a cutting edge DCIM toolset that delivers live monitoring and reporting, and it is managed by experienced data center staff.

*"...the asssessment is as applicable to well-operated facilities as to those whose performance is so compromised that a road map to recovery is essential"*

Data center ACE performance losses occur almost from Day 1, but may only manifest themselves much later in the life cycle - a result of creeping changes made over a long period of time. To counter this, the ACE performance gap should be calculated even when you believe that your facility is well operated and is not showing any obvious signs of problems. The problems are there, of course. You just can't see them... yet.

With this in mind, this white paper will show that the benefits of the assessment are as applicable to well-operated facilities as they are to those whose performance is so clearly compromised that a road map to recovery is essential. The assessment offers significant return on investment at all stages of the design and operation of a data center.

We approach the ACE performance assessment in three phases called AIM: assess, improve, maintain. And in the text that follows, we'll show you how AIM was used to maximum effect for a global banking giant.

**Techspeak:**

*predictive modeling*

The use of airflow simulation to model a wide range of theoretical scenarios – such as filling a facility to full physical capacity or failing redundant cooling units. By interpreting these results, and extracting the key performance data, availability, physical capacity and efficiency can be calculated.

## Stage 1 Assess

The first stage was to assess the designed configuration of the customer's facility, and establish the 'outer ACE performance score' (the blue triangle).

The mission critical data center was in operation and loaded to 45% of its intended design capacity when we arrived to perform a detailed on-site survey. This allowed us to create an accurate 3D model called the **Virtual Facility** (**VF**). Our automated integration tool then pulled in live monitoring and IT asset data from the customer's DCIM (data center infrastructure management) stack.

**Future Facilities White Paper Link**

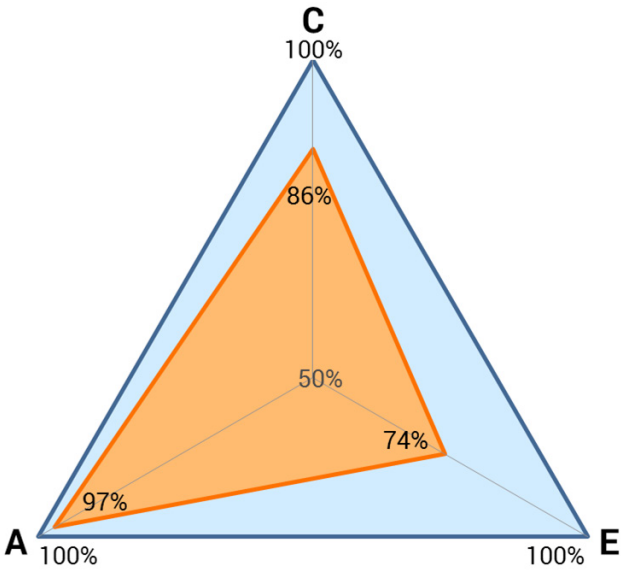
*What is a Valid Data Center Model? An Introduction to Calibration for Predictive Modeling.*

Equipped with the detailed 3D model and the live data, we were then in a position to verify the VF. It is of great importance to ensure that the simulation is consistent with the data measured in the real facility, but not everyone who models data centers actually does it. For more about calibration, click the white paper link.

Armed with an accurate VF, a range of what-if scenarios - filling the data center's racks to maximum power capacity, failing redundant cooling units etc. - were modeled. By interpreting the results and by extracting key performance data, the ACE score for the operational facility was calculated.

By overlaying the calculated performance score on to the original design score, the performance gap was identified, **Figure 1**. This clearly quantifyied the difference between giving what the client was were paying for and what the facility was actually capable of delivering.

The data center showed all the classic signs of a facility whose IT loading strategy had deviated from the plan. Efficiency and capacity had suffered... operation had not met aspiration.




### Figure 1 (Left)

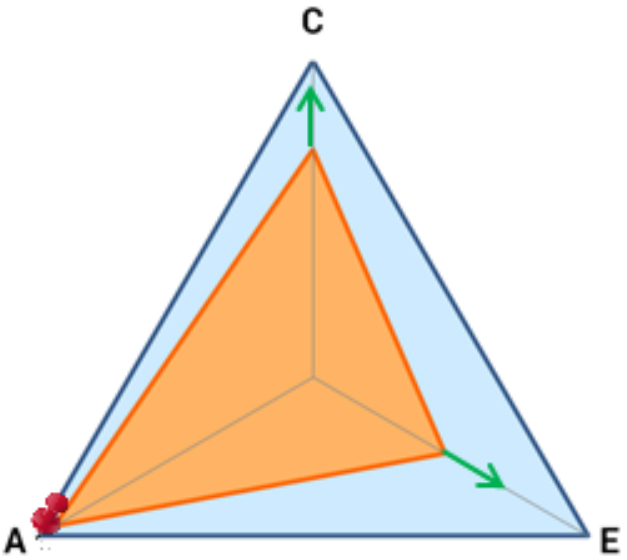
*With the outer triangle representing the aspirational design goals of the data center, and the inner orange triangle representing actual performance, our assessment showed the client their ACE performance gap (the light blue gap between both triangles). They were achieving 97% availability, 86% capacity and 74% efficiency.*

## Stage 2: Improve

The client's business objectives, visualized against the ACE performance gap, now acted as the key drivers in the ACE performance improvement state. But it was the VF itself that identified the shortcomings of the data center, and to establish where exactly improvements could be made.

In this case, mitigrating any potential availability was the main concern.

Predictive modeling was used to simulate potential solutions, and the resultant ACE performance score to assess viability of the changes.




### Figure 2 (Left)

*Because uptime was the most important business goal, we pinned availability. This meant that as we predictively modeled ways to improve ACE performance, minimize costs and maximize return on investment in the data center, we would ensure that they did not compromise resilience.*

This was the first time that the client had been able to *reliably* map out the consequences of IT and or facility changes without first making the changes in the actual facility.

### Fix Internal Rack Issues

One of the first issues identified through predictive modeling was the recirculation of hot air within cabinets; it was causing servers to overheat, threatening to reduce availability (increase downtime).

It was an important discovery, and one that highlighted the importance of not using lower end airflow simulation tools that are unable to produce reliable results about what is happening inside a facility's cabinets.

To address this, we designed customized blanking in our own 6SigmaDC software suite, and then installed it in the facility once the manufacturer had fabricated it. This eliminated internal cabinet recirculation and therefore reduced the risk of overheat, improving availability and capacity. **Figure 3**.

**Techspeak:**

*6SigmaDC suite*

software tools developed by Future Facilities for use by data center designers, owner-operators and engineers.

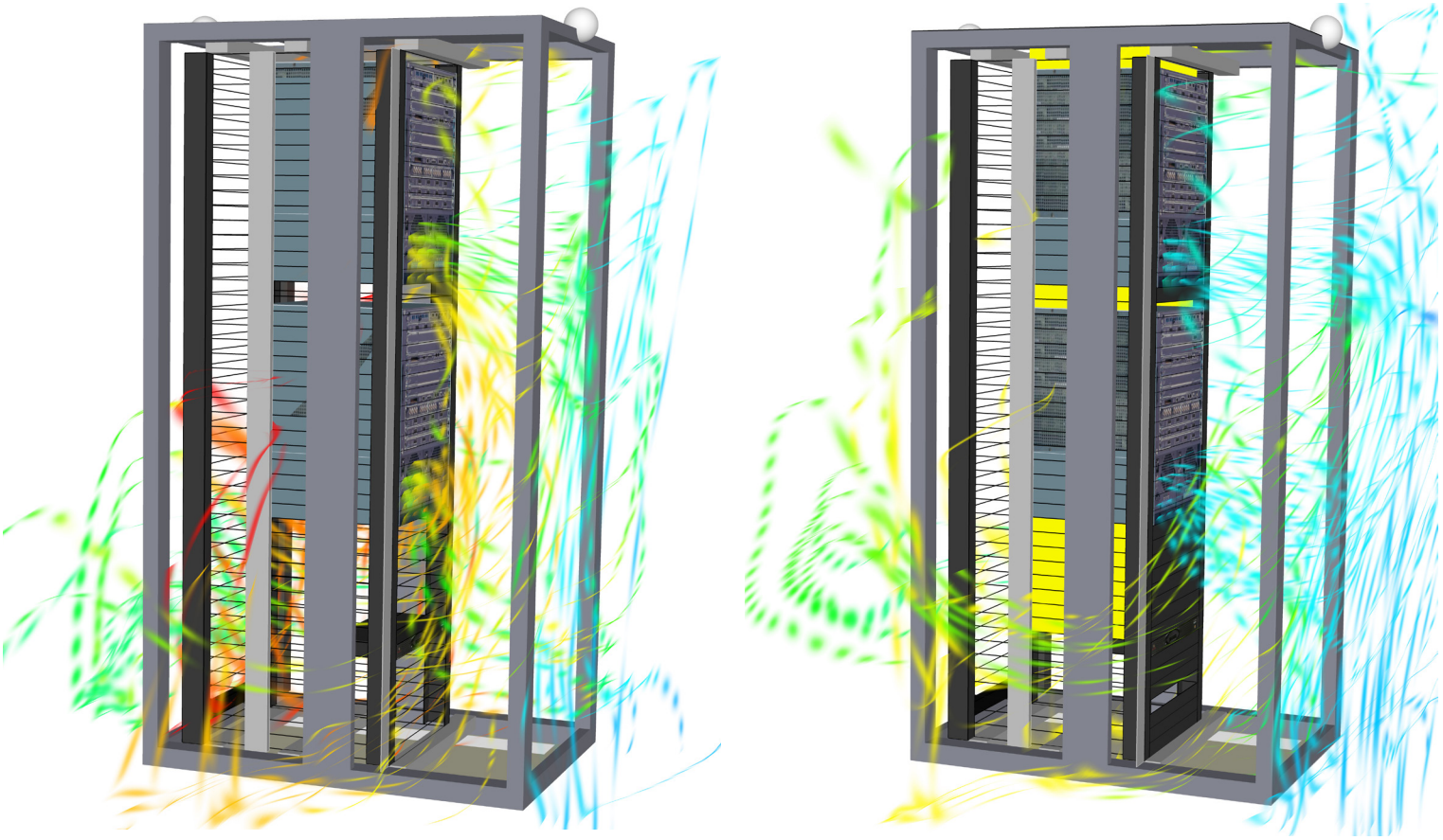


Figure 3 (Above)

*Upon assessment (left), we found that hot air (red and orange streamlines) was recirculating within the cabinets. This was overheating the IT and threatening availability. We used predictive modeling to test custom blanking - the bright yellow panels (right) - within the cabinet. Notice how the red and orange streamlines have gone.*

## Improve Airflow Delivery

The VF model identified that the cabinets at the row ends had higher inlet temperatures than the cabinets towards the centre - in plain English, they were sucking in cooling air that was actually too hot.

To address this, we predictively modeled different types of floor grilles at these locations, eventually establishing which floor grille offered the best results without actually having to install a single grille in the data center. **Figure 4**.

The 6SigmaDC suite showed us that the new grilles improved airflow delivery and, as a result, reduced the temperature at the IT inlet. Accordingly, the new grilles were purchased and installed.

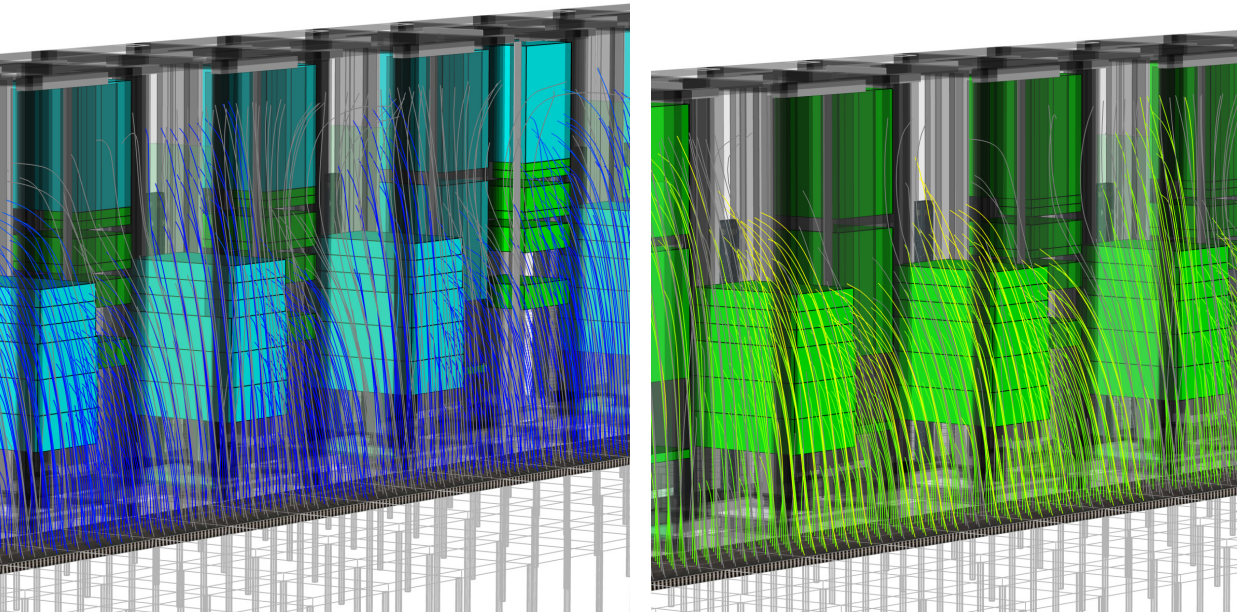
As predicted, the upgraded floor grilles at these locations improved air delivery (increasing efficiency) and therefore reduced equipment inlet temperatures (increasing availability and capacity). **Figure 4**.

## Figure 4 (Above)

*The red, yellow and green tiles at the ends of the top row denote low airflow to the equipment in the cabinets. That threatens uptime. In the bottom row, the old floor grilles have been replaced, resulting in better flow - more cold air available for the cabs at the row ends.*

## Increase Cooling Temperatures

Without losing our focus on protecting availability, we looked at ways in which we could reduce the customer's energy costs. To do so, we paid particular attention to supply air temperature. We used predictive modeling to simulate gradual increases in supply air temperature from 16°C to 22°C without risk to availability. **Figure 5.**

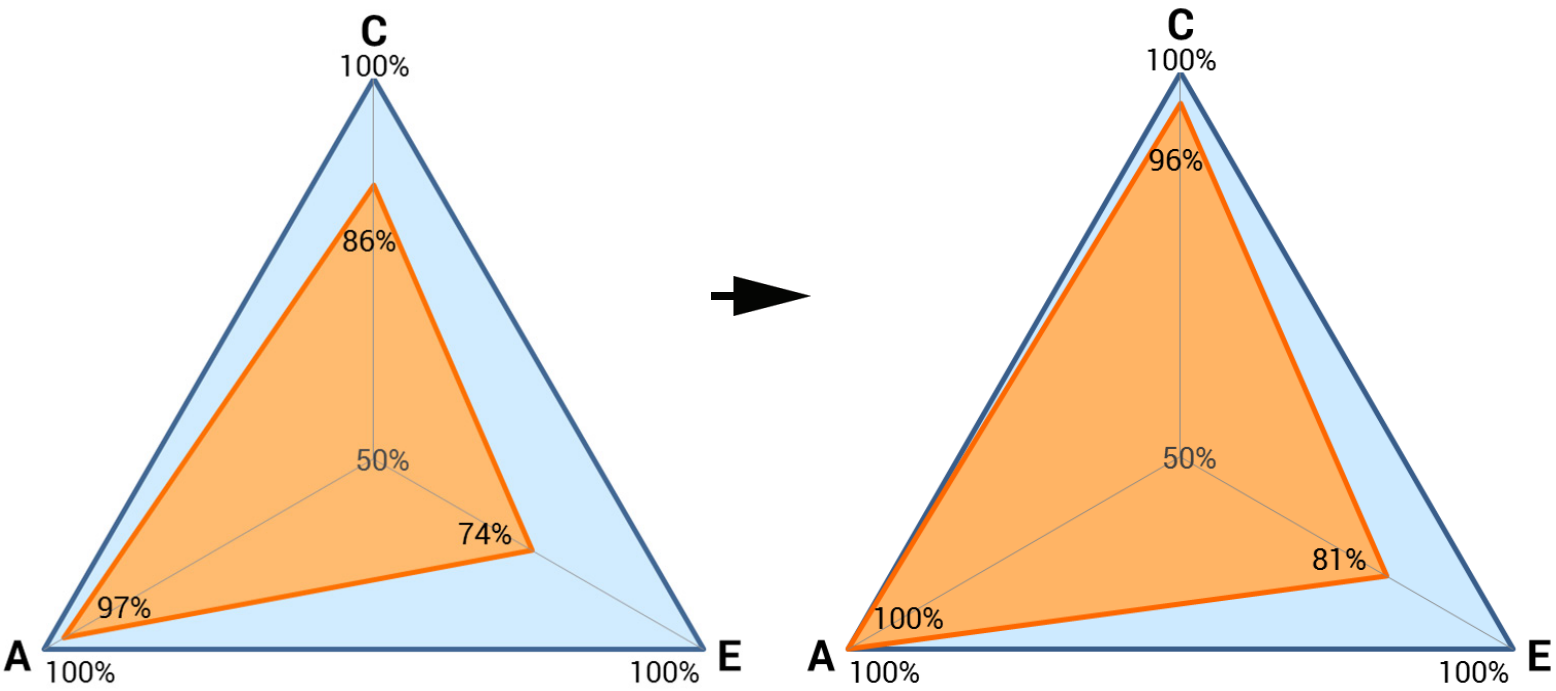


## Figure 5 (Left)

*The blue blocks and blue lines (cooling airflow) in the left row indicates "overcooling", which equates to wasted energy and overspend on cooling. In the row on the right, the blue has changed to green, which indicate that the cooling has been optimised - it is warmer but still safely within the standards recommended by ASHRAE.*

## Results - $10 million Saved

With the airflow delivery and rack issues addressed, the improvements in the ACE performance score had reclaimed **10% (350 kW) of lost capacity**. This translated to **$8.75m**, based off of the client's investment. Importantly, this was achieved at no cost to availability. **Figure 6**.




The increase in cooling airflow temperatures resulted in a further saving of **$1.15m** and a **15% PUE reduction**, without compromising availability.

At the conclusion of the improvement stage, we had increased the ACE performance score to: **A100** (97), **C96** (86) and **E81**(74).

### Figure 6 (Above)

*The light blue area between the inner and outer triangles is visibly and markedly smaller in the second ACE performance score (right). This narrowing of the ACE performance gap has saved the owner-operator $10 million.*

# Stage 3: Maintain

The next stage of the ACE assessment process was to ensure, by means of continuous modeling, that the new, narrower ACE performance gap would be maintained.

Our work at the assessment and improvement stages served to illustrate the importance of adopting a continuous modeling process. For predictive modeling to work, it was important that the client consistently kept the model calibrated to the actual facility – this way, they could detect potential deviations from their best-case scenario ACE score, then decide how to deal with them.

To enable the client to maintain their ACE performance score, we delivered three solutions:

- Integration with asset management tools to allow for the direct import of current inventory and planned deployments
- Live power monitoring for breaker upgrades and phase balances to be simulated ahead of deployment
- Training workshop for IT and facility staff on software use, and how and when to model.

Through continuous modeling, the client could then simulate the day-to-day changes in the facility and make informed decisions about their current and future IT plans, and the effect they have on the ACE performance score.

# Conclusion

ACE performance is inherently compromised in data centers. The inescapable connection between availability, physical capacity and efficiency means that you, as a data center owner-operator, must prioritize which variables to protect and which to sacrifice. As importantly, you need to be able to do so in a sustainable way.

In a business where your efforts to minimize costs are characterized by compromise, the ACE performance score provides you with the best way to sustainably achieve your data center goals.

It gives you the ability to:

- Visualize the performance gap between intended design and actual operational status
- Align the goals of the stakeholder groups in a suitable ACE balance
- Assess, improve and maintain (AIM) a facility's performance into the future through continuous predictive modeling.

The ACE performance score has been successfully demonstrated to revolutionize the way that data centers are designed and operated – our software can bridge the gap between your aspirational goals and what can actually be achieved.

On top of this, our ACE assessment service means that we can create and then execute road maps for data center recovery, providing answers and solutions that inspire confidence and offer excellent return on investment.

# Getting Technical

Client confidentiality means that in this paper we've been unable to provide engineering illustrations that outline exactly how we used predictive modeling in this case study. We have not been able to show you the virtual facility, for example.

**Future Facilities White Paper Link**

*ACE Performance Assessment - An Engineering Case Study.*

This, and the fact that this paper is not aimed at an 'expert' engineering audience means that we have also deliberately avoided granular technical detail.

However, for those wishing to learn more about the application of the ACE assessment service, the ACE performance score, or continuous predictive modeling, a third white paper in this series provides much greater technical detail using a hypothetical case study that is not commercially sensitive: *ACE Performance Assessment - An Engineering Case Study.*

# Further Reading from Future Facilities

**Future Facilities White Paper Link**

*Five Reasons your Data Center's Availability, Capacity and Efficiency are being Compromised.*

**Future Facilities White Paper Link**

*ACE Performance Assessment - An Engineering Case Study..*

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# About Future Facilities Ltd.

For a decade, Future Facilities has provided predictive modeling software and consultancy services to both the world's largest data center owner-operators and to the industry's leading consultancies.

With offices across the globe, we are unique in the market place; the only company offering an holistic solution for the data center life cycle – from inception through to operation. We call this holistic approach 'the Virtual Facility'.


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